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Avlopp – Reningsanläggning –
Del 13: Kemisk behandling – Behandling genom fällning och flockning

Wastewater treatment plants –
Part 13: Chemical treatment – Treatment of wastewater by precipitation/flocculation

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EUROPEAN STANDARD

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English version

Wastewater treatment plants - Part 13: Chemical treatment - Treatment of wastewater by precipitation/flocculation

Stations d'épuration - Partie 13: Traitement chimique - Traitement des eaux usées par précipitation/flocculation

Kläranlagen - Teil 13: Chemische Behandlung - Abwasserbehandlung durch Fällung/Flockung

This European Standard was approved by CEN on 1 November 2002.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Ref. No. EN 12255-13:2002 E

Contents

Foreword

This document (EN 12255-13:2002) has been prepared by Technical Committee CEN /TC 165 "Waste water engineering", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2003, and conflicting national standards shall be withdrawn at the latest by June 2003.

It is the thirteenth part prepared by the Working Groups CEN/TC 165/WG 42 and 43 relating to the general requirements and processes for wastewater treatment plants for a total number of inhabitants and population equivalents (PT) over 50. The parts of the series are as follows:

— Part 1: General construction principles
— Part 3: Preliminary treatment
— Part 4: Primary settlement
— Part 5: Lagooning processes
— Part 6: Activated sludge process
— Part 7: Biological fixed-film reactors
— Part 8: Sludge treatment and storage
— Part 9: Odour control and ventilation
— Part 10: Safety principles
— Part 11: General data required
— Part 12: Control and automation
— Part 13: Chemical treatment - Treatment of wastewater by precipitation/flocculation
— Part 14: Disinfection
— Part 15: Measurement of the oxygen transfer in clean water in activated sludge aeration tanks
— Part 16: Physical (mechanical) filtration [1)]

NOTE For requirements on pumping installations at wastewater treatment plants, provided initially as part 2 "Pumping installations for wastewater treatment plants", see EN 752-6 "Drain and sewer systems outside buildings — Part 6: Pumping installations.

The parts EN 12255-1, EN 12255-3 to EN 12255-8 and EN 12255-10 and EN 12255-11 were implemented together as a European package (Resolution BT 152/1998).

WARNING — The use of this European Standard may involve hazardous materials, operations and equipment. This European Standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this European Standard to establish appropriate safety and health practices and determine the applicability of regularity limitations prior to use (see also EN 12255-10).

Annex A is normative.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

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1) in preparation

1 Scope

This European Standard specifies the requirements for chemical treatment of wastewater by precipitation/flocculation for removal of phosphorus and suspended solids.

The application of polymers is not described in this European Standard.

Differences in wastewater treatment throughout Europe have led to a variety of practices being developed. This standard gives fundamental information about the practices; this standard has not attempted to specify all available practices.

Detailed information additional to that contained in this standard may be obtained by referring to the bibliography.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 752-6, *Drain and sewer systems outside buildings — Part 6: Pumping installations.*

EN 1085:1997, *Wastewater treatment — Vocabulary.*

EN 10088-2, *Stainless steels — Part 2: Technical delivery conditions for sheet/plate and strip for general purposes.*

EN 12255-1, *Wastewater treatment plants — Part 1: General construction principles.*

EN 12255-6, *Wastewater treatment plants — Part 6: Activated sludge process.*

EN 12255-11, *Wastewater treatment plants — Part 11: General data required.*

EN 12518:2000, *Chemicals used for treatment of water intended for human consumption — High-calcium lime.*

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN 1085:1997 and EN 12518:2000 and the following apply.

3.1
chemical treatment of wastewater
treatment of wastewater by chemical coagulation/precipitation with metal salts (including lime) or organic polymers in order to remove inorganic and organic phosphorus compounds and suspended solids and colloids

4 Requirements

4.1 General

Chemical treatment of wastewater can be divided into two processes: a reaction phase, that consists of precipitation of dissolved phosphates, destabilisation of colloids and the formation of flocs, and a separation phase, in which the flocs are separated from the water.

The reactors and floc separators (sedimentation tanks, flotation units etc.) for the chemical treatment can be integrated with the other parts of the wastewater treatment plant (pre-precipitation, simultaneous precipitation, see 4.2.2.2 and 4.2.2.3) or be a separate part of the treatment plant (post precipitation, direct precipitation).

The water level in the chemical reactors and tanks may be controlled by fixed or adjustable weirs. It is particularly important where there are multiple parallel reactors.

The design of the process shall take into account variations in flow and load as stipulated in EN 12255-1 and EN 12255-11.

4.2 Chemical background and process options

4.2.1 Chemical process

In order to obtain coagulation/precipitation a cationic chemical has to be added to the wastewater. Most commonly this is a salt of aluminium or iron. Lime may also be used. If only coagulation (removal of particles) is aimed at, a cationic polymer may be added alone or in addition to a metal salt.

Phosphorus can be present in the wastewater in the following forms:

a) organically bound phosphorus,

b) inorganic phosphorus,

- polyphosphate,
- orthophosphate.

Polyphosphates are eventually converted to orthophosphates and the organically bound phosphorus is converted to orthophosphate during biological treatment.

In primary treatment, phosphorus fixed to settleable particles is removed (5 % to 15 % of the total influent phosphorus depending on the character of the wastewater). In the biological treatment a certain amount of phosphorus is consumed at the microbial synthesis of new cellular material (10 % to 30 % of the influent phosphorus). By introducing an anaerobic stage where volatile fatty acids are produced and phosphates are released an increased biological removal of total phosphorus can be reached without addition of chemicals (60 % to 90 % of the influent concentration).

In the chemical precipitation, a precipitation agent (such as aluminium sulphate, ferrous sulphate, ferric chloride or calcium hydroxide) is added to the wastewater. The orthophosphate phosphorus is precipitated as metal-orthophosphate. Al^{3+} and Fe^{3+} also form colloidal hydroxides. The solubility of the precipitates is pH-dependent.

Organic polyelectrolytes are used as flocculation agents for colloidal and suspended matter.

Chemical coagulation/precipitation can be carried out in six different ways, namely

- direct precipitation,
- pre-precipitation,

— simultaneous precipitation,

— post-precipitation,

— multipoint precipitation,

— precipitation on filters.

4.2.2 Precipitation processes

4.2.2.1 Direct precipitation

Direct precipitation is used in wastewater treatment plants without a biological stage.

In a direct precipitation plant, the precipitation agent should be added after the preliminary stage (screen, grit chamber and possibly a primary settlement tank).

The precipitation agent should be added in a way that assures rapid and complete mixing of the chemical.

After mixing flocculation takes place in a flocculation tank. The chemical flocs are then separated in a final sedimentation tank or another floc separation device.

4.2.2.2 Pre-precipitation

Pre-precipitation can be used in wastewater treatment plants having both mechanical and biological treatment. With pre-precipitation, the addition of the precipitation agent is effected before the biological stage, often before the aerated grit chamber, pre-aeration tanks, or flocculation tanks. The chemical flocs are separated together with the primary sludge in the primary settlement tanks.

Chemical flocs which are not removed in the primary settlement tank are transported with the wastewater and separated in the secondary settlement tank together with the biological sludge.

4.2.2.3 Simultaneous precipitation

Simultaneous precipitation can be used in wastewater treatment plants with biological treatment depending on the activated sludge process used.

With simultaneous precipitation the addition of the precipitation agent is effected in the aeration tank, at the end of the aeration tank or together with the return sludge, where both a biological and a chemical process takes place.

The mixed biological and chemical sludge is separated in the secondary settlement tank or a flotation unit. The return sludge, the excess sludge and the mixed liquor suspended solids contain a larger part of inorganic material as compared to the sludges in a normal activated sludge plant.

4.2.2.4 Post-precipitation

Post-precipitation can be used in wastewater treatment plants with biological treatment (activated sludge, trickling filter etc.).

With post-precipitation the addition of the precipitation agent is done in a mixing tank after the secondary settlement. Floc formation takes place in a flocculation tank followed by a final clarification tank where the chemical sludge is separated. Alternatively lamella sedimentation or flotation can be used for separation.

4.2.2.5 Multipoint precipitation

The efficiency of the precipitation may be increased by adding the chemicals at two or three different points, e. g. the grit chamber, the aeration tank, the final sand filter.